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tone in the liquid, being one-half of the dry weight of the peptone. The hydrocarbons should, however, always be only from .5 to 1 per cent. of the weight of the entire liquid, and should even then serve exclusively for the formation of the walls of the cells of the yeast.

The vegetation of the yeast will take place most satisfactorily at temperatures varying from 57 to 64 degrees Fahrenheit. At a higher temperature losses may easily occur by reason of the partial conversion of the sugar used into coagulated acid or into alcoholic fermentation, instead of furnishing the yeast with substance for cells. The yeast is either propagated, as is the custom in Holland, in shallow vessels in which the depth of liquid is about five inches, so that a sufficient quantity of atmospheric air has access thereto; or it may be better and more safely effected in vats made of wood, glass, masonry, cement, or other suitable material, into which atmospheric air is conducted by suitable distributors through tubes or pipes by means of blowers or compressors.

Instead of atmospheric air alone it is more advantageous to use air containing an increased amount of ozone or of oxygen partially converted into ozone. The latter is prepared by successively adding hydrogen dioxide to the propagated liquid. The percentage of ozone in the air is increased by means of phosphorus, or by causing it to pass through a closed vessel in which permanganate of potassa is mixed with the necessary quantity of mineral acid. The air thus enriched with ozone is then allowed to pass into the propagating liquid.

The growth of the yeast will be completed within from 6 to 8 hours after every sufficient addition of dextrose, maltose, or other material, according to the density of the propagating liquid used, the temperature of the latter, and the amount of the ozone in the air. The percentage of peptone of the mass may amount to from 1 to 2 per cent. or more of its weight, while only from one-half to one per cent. of dextrose or other hydrocarbons is added at each time, in order to be sure to prevent the formation or coagulated lactic acid or alcoholic fermentation.

When the entire amount or bulk of the dextrose or other sugar added to promote the growth of the yeast has been consumed after from six to eight hours, a further quantity thereof, say, from .05 to .10 per cent. is added. The peptone may also, after having been consumed, be added in portions, or may be allowed to flow in gradually and continuously. The same propagating liquid made by successive replacement of the matter consumed remains in use for weeks or months, unless it is rendered impure by other substances, or by subsiding fermentation is made unfit for further use. In the same manner as the materials necessary for the propagation of the yeast are added the yeast produced may be successively withdrawn, and only the yeast suspended in the liquid remains behind as the germ for the ferments of alcohol to be afterwards formed. The yeast is obtained either by skimming it from the surface of the liquid or by separating it from the propagating liquid by filtration, or finally by gathering it after tapping the vats from the bottom upon which it is deposited in a compact layer. In working on a large scale it is advisable to place the vats in terraced batteries in order to effect the transfer of the propagating liquid from one vessel to the other with facility. In order to produce yeast as free as possible from subsidiary ferments the propagating liquid may be prepared in a more dilute state, that is to say, with a percentage of peptone of only from .75 to 1 per cent. The hydrocarbons (dextrose, maltose, or the like) may also be added in smaller quantities, for example, as a first dose about .33 per cent. and then every 3 hours about .05 per cent.

The greater part of the peptone present will then be transformed into yeast in from 12 to 15 hours, a sufficient supply of pure air, if necessary, conducted through sulphuric acid or oxygen containing ozone, being provided, and the entire process being carried on at a tem-

perature varying from 54 to 63 degrees Fahrenheit. The whole liquid is then cooled by a suitable apparatus, or by adding cold water or ice; the best temperature being from 45 to 50 degrees Fahrenheit. Within from 36 to 48 hours the yeast obtained will settle on the bottom of the vat. The propagating liquid may be allowed to flow away. The yeast obtained by this improved process is purified and condensed in the usual manner, but in order to increase its durability phosphate of lime amounting to from 4 to 5 per cent. of the total weight of the yeast to be made may be added before compressing it.

Experience has shown that from 250 to 300 parts of pure and active compressed yeast may be obtained from 100 parts of pure peptone. For the growth of that quantity of yeast only about 200 parts of dextrose or sugar are required.

#### MICROSCOPY.

We have received the February issue of the *Journal of the Royal Microscopical Society*, now edited by Mr. Frank Crisp, one of the secretaries of the society. It contains a valuable and interesting original paper, with two full-page illustrations, and the proceedings of the R. M. C. A summary is also presented of current research in those departments of science, depending upon the use of the microscope for their advancement. The amount of information thus gathered may be estimated from the fact that the present number is a volume of one hundred and seventy-two pages. The *Journal* appears bi-monthly, and costs one dollar (4s.) for each part.

The President of the Royal Microscopical Society announced that a fund had been provided for the presentation of two gold medals annually, without regard to nationality—one for the person who should originate any important improvement in the microscope, or any of its accessory apparatus, or in any other way eminently contribute to the advancement of the microscope as an instrument of research. The second gold medal was to be awarded "in respect to any researches in any subject of natural science carried on wholly, or in a great part, by means of the microscope, or of the recipient having in other ways eminently contributed to the advancement of research in natural science in connection with the microscope."

The two medals were to be known respectively as the "Microscopical" and "Research" medals of the Society. For reasons which are not stated, the offer of this fund was declined by the Council of the Society.

The war of Apertures of Microscope Objectives has again broken out in the R. M. S. In this instance Mr. Shadbolt was the aggressor, who claimed that his paper demonstrated beyond dispute the following facts, viz.:

"That a dry lens can have as large an 'angular aperture' as an immersion one, and that the assumed difference of aperture between dry and immersion lens does exist."

"That no lens can have an 'aperture' of any kind which exceeds that of 180° angular in air."

"That, consequently, the table of 'numerical apertures' published on the cover of the *Journal* of the Society is erroneous and misleading, and should at once be discontinued."

In reply, Mr. Crisp asserted that Mr. Shadbolt was in error, and the victim to a misplaced confidence in a fundamental fallacy, viz., "the supposition that equal angles in different media, as air and oil, are optically equivalent."

A correspondent, who is an authority on this subject, will offer an opinion on this matter. We believe, however, that Mr. Crisp is correct in his views, and that the society has exercised a wise discretion in putting a stop to a discussion, which had become wearisome and unprofitable.

Mr. Crisp showed how a few moss-grown English microscopists had persistently refused to countenance

the use of immersion objectives, which are now in universal use, and accepted as a valuable improvement.

The use of oil was suggested by Amici, as far back as 1844, by Oberhauser in 1845, and Wenham in 1855 and again in 1870, and only admitted in practice in 1878, so that it appears to have required 34 years to convince microscopists of a fact, that might have been settled in a week and this due to "persistence in a fallacy." Such being the case it is surely time for these fallacies to be shelved, and we are glad to find the R. M. S. has taken such a view of the case.

### FLUORESCENT BODIES.

If we put some common paraffin oil, or a solution of sulphate of quinine, into a glass tube or other suitable vessel, and then look through it, the liquid will appear quite colorless; but if we allow the light to fall upon it, and then view it at a little distance and at a certain angle, some parts of the liquid will present a delicate sky-blue tinge. The effect in the case of quinine is heightened if the source of light is burning magnesium wire.

The large number of substances belonging to this class are termed fluorescent bodies, because they exhibit phenomena similar to the examples above given. The term itself, however, was suggested to Prof. Stokes by a particular kind of fluor-spar which shows this property.

Again, if we cause a room to be darkened, and allow only blue light (*i. e.*, by covering a hole in a window-shutter with cobalt-blue glass) to fall upon a glass vessel filled with water which has been standing some minutes, on floating a strip of horse-chestnut bark upon its surface, in a few moments a stream of bluish grey fluid (*æsculin*) will be seen slowly descending from the bark, hanging, in fact, like a bunch of barnacles from an old ocean waif. Or if, under the same arrangement of light, or by using even more powerful absorbents of the ordinary rays (such as a solution of ammonio-sulphate of copper or one of chromate of potash), we look at a piece of what is commonly termed canary glass—*i. e.*, glass colored with an oxide of the metal uranium—it will be seen to glow as it were with rich greenish yellow rays, just as though it were itself a source of light; or if we take a solution of a uranium salt (the normal acetate) the phenomena are very striking when examined under the same conditions, and still more so by the electric light. But the salts of aniline—a substance which is the parent, so to speak of mauve, magenta, and other brilliant colors—are singularly rich in exhibiting these effects.

A very beautiful experiment may be performed with the aniline red ink now so commonly in use. It affords, at one and the same time, an admirable illustration of Prof. Tomlinson's submersion figures and of the phenomena under consideration. If we take a long cylindrical glass vessel, or one with parallel sides, fill it with water, which is allowed to settle, and then gently deliver a drop of the red fluid to the surface, the drop begins to contract, and slowly from its centre descends in the form of a tube; the denser parts of the coloring-matter presently form a thick circular rim at the end of the tube,—but this is only for a moment, for a wavy edge appears upon this rim, then expands into a triangular parachute with a thickened edge, and from the extremity of each corner two or three smaller tubes descend; these in like manner pass through the same phases as the parent stem or tube.—*E. R. Hodges (Journal of Science, London.)*

### INTRA-MERCURIAL PLANETS.

A collection of the observations published in the report of the Total Solar Eclipse of 1878, will give, perhaps, the best idea of the present state of the question of the discovery of Vulcan and other planets revolving within the

orbit of Mercury; and it may be of some interest to present the matter in the form of a chart showing the ground covered by different observers, who, during the time of totality, devoted themselves to the search for such bodies. For this purpose, the space swept by the six observers, Newcomb, Hall, Wheeler, Bowman, Todd and Pritchett, has been indicated by different shading on the accompanying chart, which is merely a copy of that prepared by Prof. Hall for the use of observers of the eclipse, and published with the instructions issued from the United States Naval Observatory.

The two objects, "*a*" and "*b*," discovered by Prof. Watson, and thought by him to be planets, have been indicated upon the map thus: ☉. The two discovered by Swift, also announced as intra-mercurial planets, have been marked thus: ⊗.

Swift's two stars are described as equal in brightness, of about the fifth magnitude, and 8' apart; on a line with the sun's centre. Each had a round red disk, and each was free from twinkling. The object farther from the sun was at one time thought by Swift to be  $\vartheta$  Cancrī, and the other a new planet. The diameter of the field of view was 1°.5.

Watson's star, "*a*," is described as being "between the sun and  $\vartheta$  Cancrī, and a little to the south;" of a ruddy color and about 4th magnitude, or fully a magnitude brighter than  $\vartheta$  Cancrī, which was seen at the same time. The star, "*b*," was also of a ruddy hue, and is given as the 3rd magnitude.

Watson used an aperture of 4 inches; magnifying power of 45 diameters; Swift, an aperture of 4.5 inches; power of 25 diameters. We see by inspecting the chart, that the place of one of Watson's stars (that of which he was the more certain) was covered by Wheeler with a 5-inch aperture; power 100; by Pritchett, 3.5 inch aperture, power 90; and by Bowman with a 3.5 inch aperture and power of 30 diameters. The place of Swift's two stars was examined by Bowman and Wheeler, and one of the stars appears just in the corner of Pritchett's sweep. Finally, the whole ground was covered by Todd with a 4-inch aperture and power of 20.

Of these observers, Wheeler and Pritchett possessed telescopes with optical power at least equal to that of Swift, or Watson, and Bowman's glass was of sufficient power to show any object as large as the 5th magnitude,—but nothing, not already upon the chart, was found.

This should be borne in mind, however, that several of the observers were enabled to make but very hasty sweeps,—not devoting so much of their attention to the subject as Watson did, and, indeed, at Mr. Todd's station clouds interfered seriously with the work. And, on the other hand, it appears that Prof. Watson devoted a large part of his time to sweeping on the east side of the sun.

A glance at the chart will show that Watson's stars have about the same relative positions and magnitudes as  $\vartheta$  and  $\zeta$  Cancrī, and that Swift's stars as far as relative position is concerned, resemble closely  $d^2$  Cancrī and B. A. C. 2810, or the pair of stars similarly placed on the other side of the sun. The probability of an error in pointing the telescope, which would account for such a misidentification as has been suggested, has been thoroughly discussed by Dr. C. H. F. Peters in the *Astron. Nach.*, No. 2253, p. 323, and Dr. Peters' paper has been answered by Prof. Watson in the next volume, *Astron. Nach.*, No. 2263, p. 101.

It is not the intention of this article to consider again the question of the identity of the stars seen by Watson and Swift, but merely to point out the evidence upon which the discovery of "Vulcan" rests, and to call attention to the fact that the existence of an intra-mercurial planet is not yet admitted by the majority of astronomers of the present day.

W. C. W.

WASHINGTON, D. C., February 24, 1881.